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A DATA BASE MANAGEMENT SYSTEM
FOR TRAFFIC ENGINEERING DEPARTMENTS
OF SMALL AND MEDIUM-SIZED CITIES

by

Karsten Baass* and Bruno Allard*

CENTRE DE RECHERCHE SUR LES TRANSPORTS



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ABSTRACT

Most traffic information systems now in use are inadequate. The data they contain are often inaccessible, incompatible with other data bases and rarely up-to-date. Furthermore, the data are rarely fully exploited since they are usually in manual form. The proposed system attempts to solve these problems. It is a data base management system based on dBASE III Plus and includes an integrated urban data bank and three types of software for information systems management, information retrieval and interfaces with application programs. A sector of the city of Québec was used to test the feasibility of the system. Although limited, the use of the data shows that the proposed system has distinct advantages over existing approaches. It will become even more attractive as cheaper, more powerful and more versatile micro-computers enter the market.

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RÉSUMÉ

La plupart des systèmes d'information urbaine utilisés actuellement s'avèrent inadéquats. Les données sont souvent inaccessibles ou incompatibles avec d'autres bases de données et elles sont rarement à jour. Pour toutes ces raisons, elles ne sont jamais exploitées pleinement. Le système proposé a pour but de résoudre ces problèmes. Il s'agit d'un système de gestion de données, basé sur le logiciel dBASE III Plus qui inclut une base intégrée de données de circulation de même que trois types de logiciels pour la gestion de l'information, pour son extraction ainsi que des interfaces avec des programmes d'application. Les données de circulation d'un secteur de la ville de Québec ont été utilisées pour étudier la faisabilité du système. Cette application montre que le système proposé présente de nombreux avantages et deviendra plus attrayant et plus utile encore, au fur et à mesure que des micro-ordinateurs plus puissants et moins chers seront plus communément utilisés par les bureaux d'ingénieurs et les bureaux gouvernementaux.

In the transportation planning and traffic engineering field, information needs are of a great variety and consequently data at different levels of detail and precision are needed. One can distinguish between four principal groups of information users, which correspond to the levels of hierarchy of the transportation administration. These are: the executing personnel (at the technical level), the planners (at the tactical level), the executives having administrative or managerial authority in the organization (strategic level) and finally the users from outside the organization who represent an important and noticeable group due to the great public interest in the transportation domain. Figure 1 illustrates the differences in the information needs of these groups.

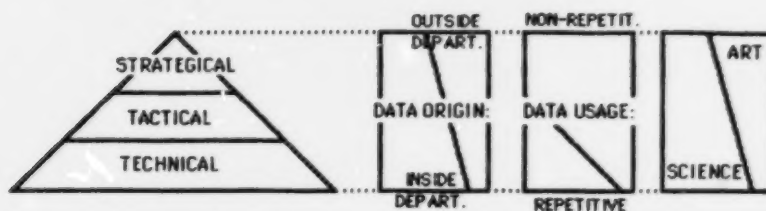


Figure 1. The different information needs.

The technical personnel, responsible for the daily operation of the system, requires very detailed information which should be precise and up to date. This basic information is generated and collected mostly by the department itself. The need for data at this level is constantly growing due to the introduction of computerized procedures and expert systems for design and operation. On the other hand, planners need data coming from various sources (for example from other city departments) that may be less detailed and less recent. The administrative or managerial authority of the department requires synthesized and more global information, which should be available rapidly in order to allow optimal decision making based on facts. Finally the external users such as citizen groups, consulting engineers and more frequently lawyers, need particular and precise information. These users are more often poorly served by the existing information systems and it is here where the public realizes its inadequacy. A good information system should satisfy all these different needs.

Computerized information systems have evolved rapidly; from application program oriented data bases to complex data base management systems (DBMS). Figure 2 shows the basic principle of such a system. DATE (1982), KROENKE (1983) and KRUGLINSKI (1983) can be consulted for further reference.

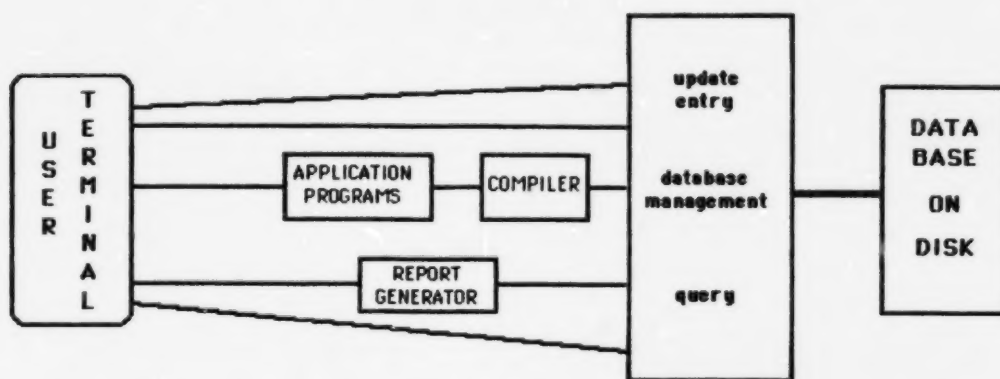


Figure 2. A data base management system

Today many pre-programmed DBMS packages, on large scale and micro-computer are widely available. These have many interesting features and supply information in a users friendly way, as well as supplying information which one could otherwise obtain only by very time consuming and extremely expensive programming. These programs can also be used efficiently for the management of urban transportation data.

Some of the more important objectives to pursue in the design of an urban information system are the following: (These objectives can be attained by certain commercial DBMS)

- independence of data (Two data are independent if modifications can be carried out on one, without regard to the other.)
- non redundancy of data (This is an important requirement with respect to storage and to the updating process.)
- interrelation between different urban data by common references.
- integrity of data
- modularity of the system

From the users standpoint a good DBMS should provide:

- multi-user capability
- simplicity of use and a comprehensive documentation(full screen editing, on screen display format generation, report generator, easy query facilities etc.)
- restructure ability. Since the users need may change in time the system should allow addition to or deletion of data records.
- Security of data by a password or other control procedure.
- easy updating of data

Due to the commercially available DBMS the complex duties of data management become easy. These programs also offer enormous advantages in the field of traffic engineering where great quantities of data have to be stored, treated and analyzed. Because the traffic engineering department is part of the urban services and one wishes to solve urban problems in a more global way, a traffic information system should be integrated into the data of the other urban services to avoid the problems of redundancy and difficulties in data transfer between services. Figure 3 shows how one could design this urban information system (UIS). Common references, such as the links and geocoded nodes of the street network, would permit exchange and integration of data between city departments. All departments are using the same programs for interactive interrogation and exploitation of the data base. Control, security, updating and data entry depend on one authority. In theory this UIS is ideal. It is fast and efficient, centralized, integrated and modular and makes maximal use of the data which are so expensive to collect and to keep updated. But there are only a few municipalities undertaking the task of establishing such a system due to the very high expenses. The administration of a city touches so many domains, that an adequate design for all users seems to be very complex. So complex indeed, that the creation of two systems was often proposed; one for planning and one for urban operation purposes.

From a practical standpoint the centralized UIS is often questioned since the user is dependent on a central system over which he has no control especially if his queries are not considered a priority by the UIS administrator.

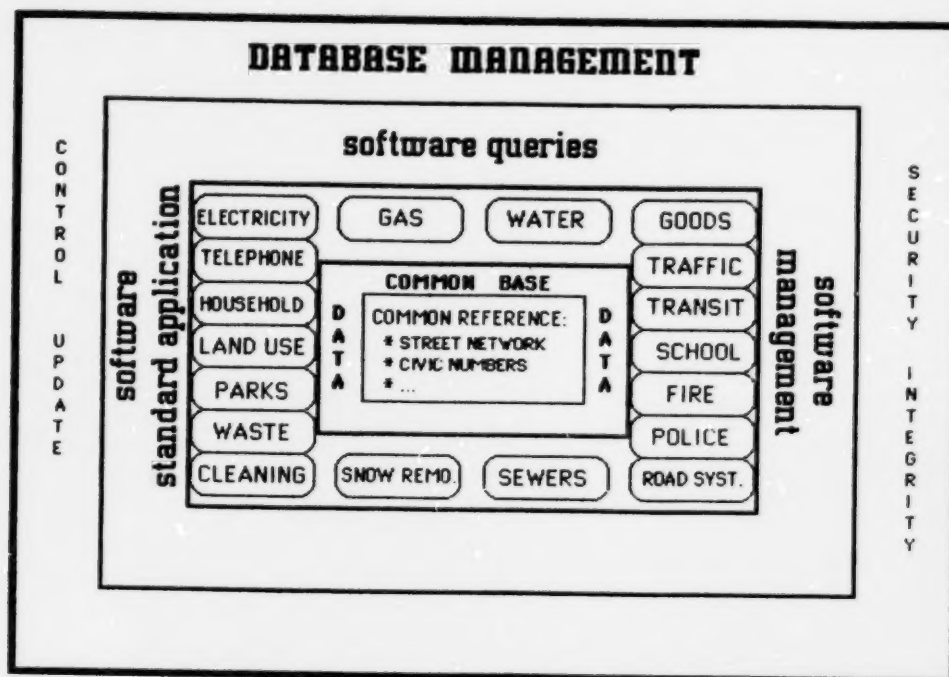


Figure 3. Diagram of an integrated urban information system (UIS)

And finally, the mere size of such a centralized data management system seems to contribute to its failure. Recent developments in the field of networking of micro-computers indicates, that the centralized approach could soon be replaced by a decentralized one.

For these reasons, the development of a global UIS does not seem to be the way to follow for a municipality with little or no experience in the domain of data base management. To avoid the problems related to the implementation of a global information system, a municipality could start temporarily with a DBMS in each and every of its departments.

A central authority should assure that these data systems remain compatible with one another (for example by providing a common geocoded network as a reference). Communication between data bases of the different departments would then easily be possible. This procedure would, however, not eliminate redundancy of certain data and cause some problems in updating elements common to all data bases.

But since there are relatively few common data (at least at the operational level where the availability of recent data is a must) this approach would represent important advantages compared to the situation presently encountered in many municipal departments. This partial data base would allow the start of computerization (once data are stored on disk they can always be reused or restructured) and would be a transitional stage necessary to fill the gap between the manual information system and a fully integrated UIS.

THE INFORMATION SYSTEM FOR A TRAFFIC ENGINEERING DEPARTMENT

The decentralized approach in the design of a DBMS in traffic engineering was adopted. In an early version, started at the end of the 1970's, the problem was attacked by programming on a centralized main frame computer. Part of the interactive query and management programs were written. But very soon it appeared that this would necessitate a significant investment in programming effort or would require the acquisition of expensive DBM programs. Management often depends on the expertise of programmers and many wish to preserve that dependent relationship. Software houses offering programs for main frame computers have traditionally not offered packages that permitted computer end-users to by-pass the programmers. The first data base systems were thus complex and difficult to use. Only recently, systems on micro-computers as sophisticated or more so than those on large computers became available.

It was then decided that an information system based on a commercial DBMS on micro-computer should be designed, supposing that micro-computers would develop rapidly with respect to their storage capacities and rapidity of execution. It was also expected that the available DBMS would also become more and more sophisticated and would grow with the needs of the user community.

It was decided to use dBASE II, which was then widely available and, even considering the limitations of this earlier version, it appeared, after having conducted a pilot study, that the commercial packages were in fact satisfactory for the purpose.

dBASE is a relational data base management system where data are stored and related to another by relations. The files, under certain conditions, can be considered as mathematical relations and the mathematical theory of relational algebra can be applied to problems of dealing with the data in these files. One of the basic advantages of a relational data base is that one does not have to

anticipate all the needs when the files are set up. dBASE is now in its third version (III PLUS) and nearly all of the objectives cited earlier are attained by the program. A continuity between different versions is also guaranteed, so that data can easily be accepted from the older versions.

The management of the data bank (security, updating, data entry, modification of the data structure, adding new data items and so on), the query language and the report preparation are all very well developed.

There is a query facility for non programmers to view, enter and update the data and a report generator orienting the information to paper instead of to the screen. A special programming language as part of the DBMS can be used to program any report based on the data. The DBMS allows the data to be read and data files to be produced for application programs in BASIC, FORTRAN, LOTUS or other. One basic requirement in a practical environment is to allow access to the data base by several users at the same time. The network environment is presently in rapid state of evolution and the newest version of dBASE allows multi-user operation.

There are in fact a number of access and update security codes which not only protect the data values but also relationships between data. Files are protected by data encryption. They cannot be read until they are deciphered or decrypted. A users profile is created with an encryption code and a password. No user can gain access to the DBMS unless he provides a log-in that can be validated. There are 8 different privilege levels for reading, updating, extending and deleting data where 1 is the fullest privilege. These privileges are established by the data base administrator and fixed in the users profile.

The built in local area networking (LAN) (see figure 4), together with the password protect system allow some network users only to enter data, while others create and maintain the data bases, command files or applications. Referring to figure 1, different codes are attributed to different levels of users.

There is also a run time package which allows to run a compiled version of the dBASE application program without buying the DBMS program. This makes the application more efficient and faster.

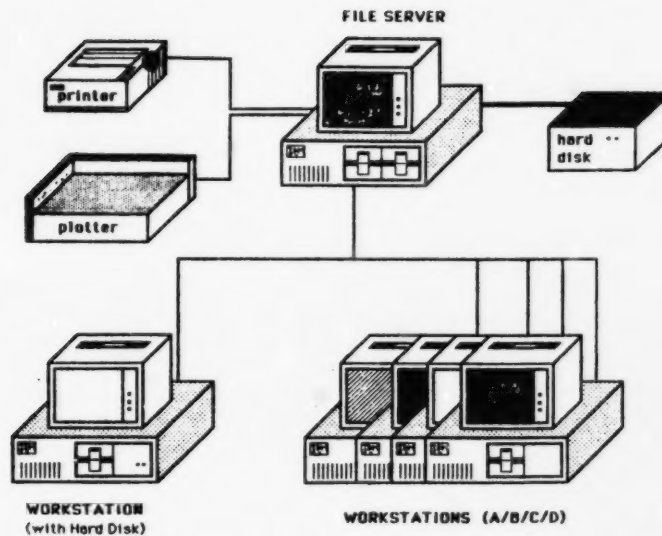


Figure 4. The LAN environment

THE DATA BASE

Data Integration

Since one should tend towards the goal of data sharing between different city departments and attain a future integration of the data, the most basic question to answer is how to establish the basic relation by appropriate linkages.

Urban information pertains to different entities. Nora (1974) has identified several:

- individuals;
- corporations;
- public equipments;
- buildings;
- building lots;
- street segments;

It appears that geographical coordinates are the best, while not exclusive, means of urban data integration since most of the entities have in fact a spatial dimension. Traffic and transportation data are primarily associated to road segments, which can be geocoded by x-y coordinates and by map digitizing

after having represented the street network as a network composed of links and nodes. A road segment is thereby represented by two nodes at the street intersections with intermediate nodes, if necessary for a better graphical representation.

The DIME (Dual Independent Map Encoding) developed by the US Bureau of Census in 1970 is one such system (SILVER, 1980). The proposed reference system is very similar to the DIME system (see figure 5) and uses the UTM (Urban Transverse Mercator System) coordinates, which will allow an integration of Canadian census data. into the data base.

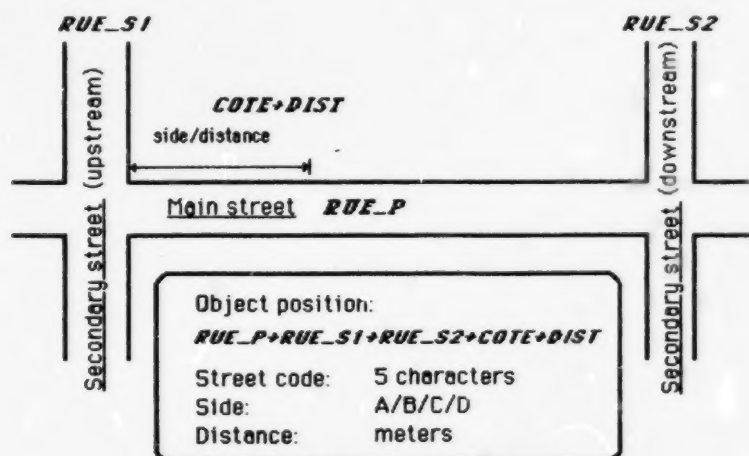


Figure 5. Description of the reference system

The contents of the traffic engineering data base

There are two kinds of data related to traffic engineering. These are those related to an intersection (as traffic light parameters for example) and those related to the street segments. Some rules for data collection and data entry are necessary, but most departments have adopted a way similar to the one described by figure 5 to enter segment related data. There is a special application program that calculates for each item entered in the data base its x-y coordinates based on the coordinates of the nodes describing the segment. This allows an easy and fast graphical to scale representation of the data.

The following data are considered:

Segment related:

- General data
 - . Civic numbers
 - . Private entrances
 - . Street lamps
 - . Bus shelters
- Geometry
 - . Width
 - . Nodes
 - . Links
 - . Islands
 - . Turning lanes
- Traffic control devices
 - . Location
 - . Traffic sign type
 - . Conditions day and night
 - . Maintenance dates
 - . Pavement markings
 - . Sign posts
- Traffic information
 - . Volume
 - . Traffic composition
 - . Spot speeds
 - . Overall travel speeds
 - . Delays
 - . Capacity
 - . Class of the street
 - . Parking
- Accident information
 - . Information corresponding to the standard accident report used in Quebec
- Pavement nature and
 - . Road surface condition
 - . Roughness
 - . Structure
 - . Bearing capacity
 - . Cracking
 - . Maintenance

and intersection related data:

- Geometry
 - . Turning radius
 - . Islands
 - . Sidewalks
 - . Nodes and links
 - . Lanes and turning lanes
- Traffic signs
 - . Location
 - . Type with code
 - . Condition of sign
 - . Maintenance
 - . Pavement markings

- . Sign posts

- Traffic lights
 - . Cycle
 - . Splits
 - . Phases
 - . Controller
 - . Traffic light (type, condition)
- Traffic information
 - . Volumes
 - . Traffic composition
 - . Capacity
 - . Saturation flow
 - . Buses
 - . Parking

This information, when gathered and stored in the DBMS, will contribute to better management, will permit identification of deficient system elements and allow to prioritize and schedule maintenance work. It will also be most helpful in answering queries from the public and be useful in legal problems when it has to be shown that the traffic inventory is up to date and stored and treated on a modern and efficient state of the art system.

GENERAL DESCRIPTION OF THE SYSTEM

The initial problem of design was to define an efficient structure of data storage since the way data is stored influences on the efficiency of the DBMS. Yet the structure had to be flexible enough to adapt to the changing demands of the user. This requirement was met since dBASE allows fairly easy modification of the data structure. Certain weaknesses of the information system, appearing during its use, can thus be corrected in a convenient way.

After the starting screen, giving the logo of the system designed by ALLARD (1985), the user is asked to fill out the log-in menu (figure 6) with a code and a password. This menu enables the user to change certain features as for example the colors of the menus and the data bases to be used (if there are different city departments for example).

There are two modes of operation of the system, these are by menus or by macrocommands. Menus facilitate greatly the use of the program, but the user is limited to the options offered on the menus, which underlines the necessity to provide an adequate choice to the user. In fact, the options on the menus were chosen by the potential system users. Standardization and simplicity of the

menus was achieved by designing all menus corresponding to the standard layout on figure 7. The menus are designed with the help of an on screen cursor design program (for example QUICKCODE, 1984).

ADD		Time: 14:58:12	
LOGAN / C	USER PROFILE	Date: 06/20/86	User: BRUNO
NAME (f):	CODE	NAME (l):	PASSWORD
TITLE			
Color definition		Reading file (specify the drive and the path) (ex: E:\DBASE\)	
colors A :	Unit A :	dBASE program.	
colors B :	Unit B :	databases	
colors C :	Unit C :	SDF file	
colors D :			
colors E :			

Figure 6. A user's profile.

LOGAN/C

name of option

Time: hh:mm:ss
Date: mm:jj:gg
User: code

subset

menu number

database: PANNEAUX.DBF

A) Add data
B) Browse
C) Copy (SDF format)
D) Index
H) Update
R) Report
S) Statistics
Y) Validation

D) Return to main menu
F) End this menu
H) Help
P) Printer (setting)
X) Exit to DOS

Select an option:

Menu title

Time and user identification

Database name

Available options

Standard options

Messages

Figure 7. The standard for menu design.

There are several levels of menus which are distinguished by different color arrangements, defined in the users profile. The hierarchy of the first two levels is shown in figure 8.

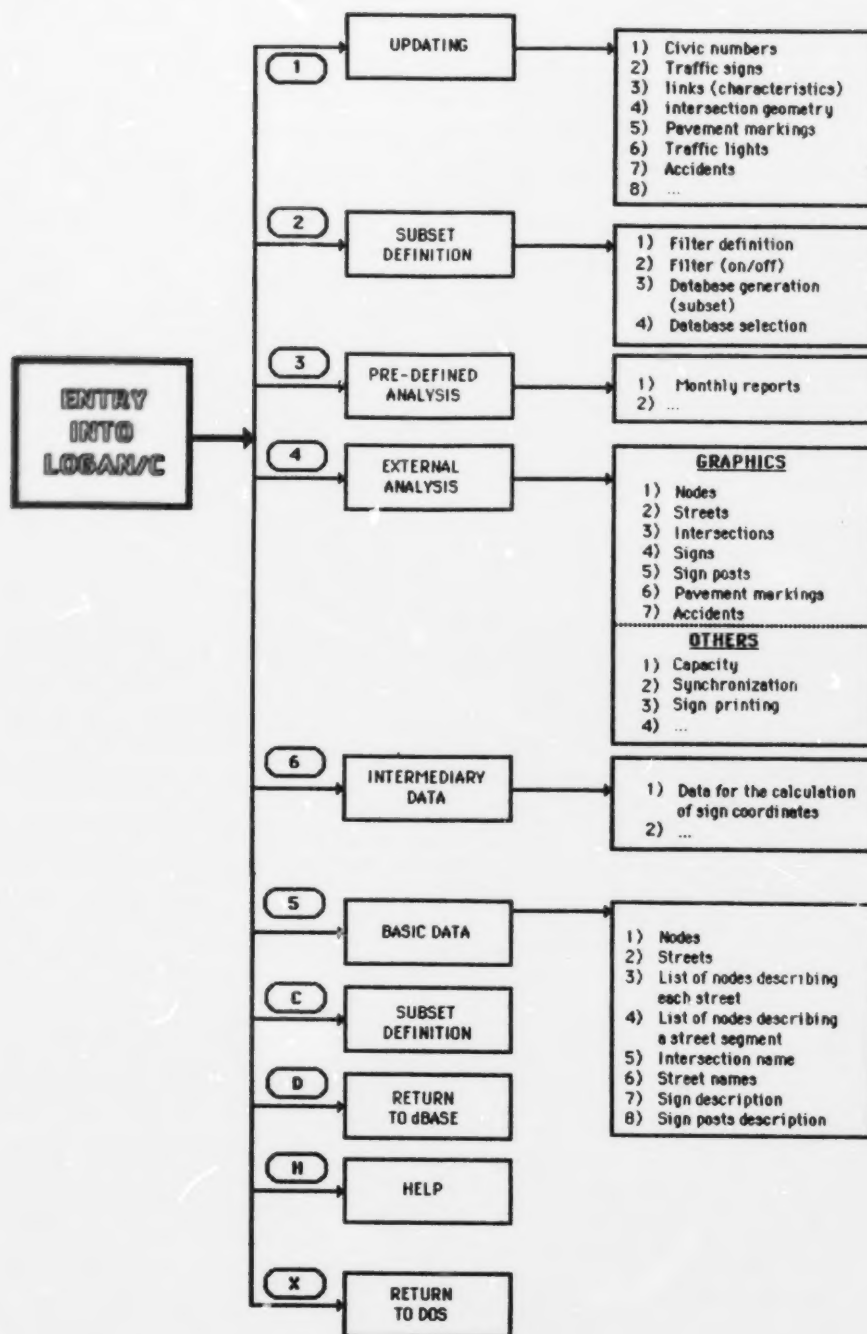


Figure 8. The first two menu levels of the information system

The main menu in figure 9 shows the basic options available at the moment which correspond to the basic tasks, data management, traffic studies and analysis.

<pre> ***** # L O G A N / C # ***** </pre>		<pre> Time: 14:50:06 Date: 06.20/86 User: BRUNO </pre>
1)	Updating data	
2)	Subset definition	
3)	Pre-defined analysis	
4)	External application	
5)	Entrance of basic data	
6)	Intermediary data	
C)	Configuration/user profile	
D)	End of dBASE	
H)	Help	
X)	Return to DOS	

Figure 9. The main menu of the information system

Options 1, 5 and 6 allow data entrance, validation and updating. Option 2 can be chosen to establish a new data base as a subset of the original base while option 3 represents the query part, where direct commands available by dBASE permit the display, on screen or in print, of the contents of the data base or part of it. On an intermediate level, between these "in house" commands and the application programs, are the pre-programmed repetitive reports generated by the report generator of dBASE. The design of these reports requires some knowledge of the dBASE programming language. The elements described are necessary for the inventory and operation of the traffic service and are as such very useful on the technical level, but graphical output is also very useful.

These applications cannot be done directly by existing commands of the data base management system. These applications are accessible by choosing option 4 of the main menu. The programs are written in FORTRAN and data are extracted interactively from the data base.

The remaining options facilitate work with the system for example by giving explanations about the functioning of the system (help). LOGAN/C was designed to be used in the french language; but the menus in the following application examples were translated for easier understanding.

Examples of work to be done by the information system

a) Updating the information in the data base.

This task is been done by chosing option 1 on the main menu. Menu 1-1 (figure 10) appears on the screen, from where we chose number 1 for updating of the civic numbers.

logan / C	=====	Time: 13:59:05
	DATABASE UPDATE	Date: 06/20/86
	=====	User: BRUND
	1-1	
1)	Civic numbers	
2)	Traffic Signs and sign posts	
3)	Links (characteristics)	
4)	Intersection geometry	
5)	Pavement marking	
6)	Traffic lights	
7)	Accidents on links	
8)	Traffic counts	
		D) Return to main menu
		F) Exit this menu
		H) Help
		X) Return to DOS

Figure 10. Menu giving access to the different data bases

This choice produces the menu 1-1-1 illustrated by figure 11 and displays 9 different options from adding of data to updating, validation, browsing through the data base and so on.

LOGAN / C		Time: 13:55:12
CIVIC NUMBERS		Date: 06/20/86
update		User: BRUND
1-1-1		
A) Add data B) Browse C) Copy (SDF format) I) Index M) Update R) Report S) Statistics V) Validation W) Subset		database: CIVIQUE.DBF
Select an options:		D) Return to main menu F) Exit this menu H) Help P) Printer (setting) X) Return to DOS

Figure 11. Menu for work on the civic numbers

The option A on this menu produces a lower level of menu, which permits to add new information. (see figure 12).

LOGAN / C		Time: 14:59:05
CIVIC NUMBERS		Date: 06/20/86
update		User: BRUND
1-1-1.A		
Codes Census track ID Full names (output)		
main street:	:	:
second. street (upstream):	:	:
second. street (downstr.):	:	:
street side:	:	:
distance from intersect. (upstream):	:	:
Address number		
civic number:	:	:
fraction code:	:	:

Figure 12. Entrance form for data on civic numbers.

b) Predefined and "ad hoc" analysis

Option number 3 from the main menu gives access to analysis on the data base. Certain analysis are required periodically. A program extracting the information and displaying it in a certain manner on screen and on printer is pre-programmed in order to facilitate the production of these repetitive reports. 4 typical examples are given on the menu in figure 13.

LOGAN / C	=====	Time: 15:34:05
	PRE-DEFINED ANALYSIS	Date: 06/20/86
	=====	User: BRUND
1-3		
1) List of signs requiring maintenance		
2) Number of signs per type		
3) Number of fatal accident per street		
4) Number of accident per type		
D) Return to main menu		
F) Exit this menu		
H) Help		
P) Printer (setting)		
X) Return to DOS		

Figure 13. Predefined analysis

One of the advantages of the DBMS is the possibility to query directly the data base and to extract the desired information. Thus, a subset of data is obtained without complex programming. Boolean operators of relational algebra can be used to create new associations or to obtain a subset of data. Two examples of such "ad hoc" analysis may illustrate its potential.

In the first example a list is needed of all traffic signs on Cote d'Abraham, whose five letter code is 'CABRA'. We use the data base PANNEAU (or traffic sign).

The commands are: USE PANNEAU
LIST FOR RUE1='CABRA'

Figure 14 illustrates the names of variables and data base names used in the examples.

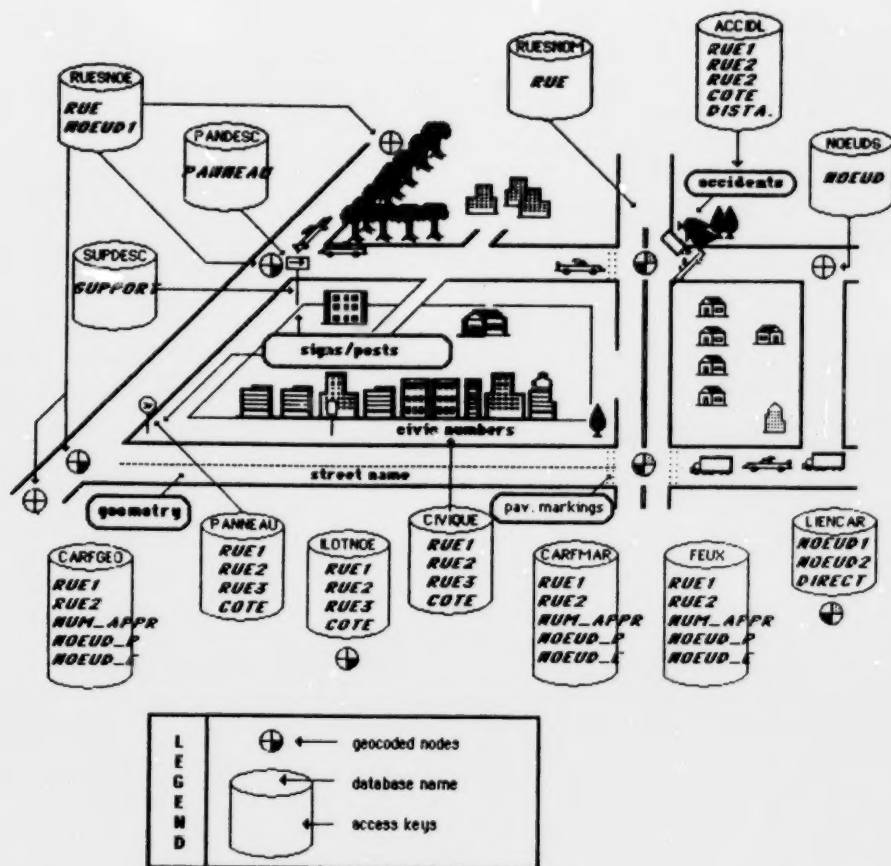


Figure 14. Names of variables and data bases

In the second example we want to obtain the traffic signs which have a day visibility code of 3 or more on Cote d'Abraham and this upstream from the intersection with 'SVALL' between 20 and 1000 metres from that intersection. Figure 15 illustrates the menu which achieves this and which also displays the names of the variables and their description, thus avoiding the research in the dictionary.

LOGAN / C	*****	Time: 11:24:32
DEFINITION / UTILISATION	*****	Date: 06/21/86
***** OF SUBSET	***** 1-2	User: BRUNO
1) Definition of filters on database 2) Filters (on/off) 3) Generation of new databases [*] 4) Choice of database subset		
* Use option 1 to specify the conditions		
D) Return to main menu F) Exit this menu H) Help P) Printer (setting) X) Return to DOS		

Figure 15. Menu used for the definition of a condition for extraction of data from the base.

Another interesting feature is presented by option 2 of the main menu which permits the generation of sub-sets of data by defining filters on the data bases. Figure 16 is the corresponding menu and figure 17 is displayed after having chosen option 1 in menu 1-2.

FIELD NAME	DESCRIPTION	FIELD NAME	DESCRIPTION
RUE1:	(C5) Main street name	D_FABRICA(D)	Fabrication date
RUE2:	(C5) Second. street name (up)	D_INSTALL(D)	Installation date
RUE3:	(C5) Second. ... (downstream)	D_ENTRETI(D)	Maintenance date
COTE:	(C1) Street side (A/B/C/D)	HAUTEUR (N2)	Height (cm)
DISTANCE (N6)	Dist. from intersect.	DIM_LARGE(N2)	Width
PANNEAU (N4)	Sign number	DIM_LONG(N2)	Length
CO_FLECHE(C1)	Arrow code (from sign)	C_REEMPLAC(N1)	Reason for maintenance
SUPPORT (N4)	Sign post number	FABRICANT(N1)	Supplier
SURFACE (N1)	Sign post surface		
ETAT_JOUR(N1)	Sign visibility: day		
ETAT_NUIT(N1)	Sign visibility: night		
VISIBILIT(N1)	Sign reflectorization		

Example: RUE1='CABRA'.OR. RUE1='SREAL'.AND. RUE2='SVALL'.AND. DISTANCE > 20
AND. DISTANCE < 1000.AND. D_ENTRETI < CTOD('10/20/85').AND. ETAT_JOUR > 3
ENTER YOUR CHOICE

Figure 16. Menu used to define a subset on the data base.

LOGAN / C		Time: 14:59:05
DEFINITION		Date: 06/20/86
subset 1-2-1		User: BRUNO
Subset title:		database name
Subset name		FILTRE.DBF
Description of subset (optional)		
Database name :ACCIDENT:		
Conditions		

Figure 17. Menu for the definition of a subset of the accident data base.

In many cases in traffic engineering it becomes necessary to use the data as inputs to application programs. Option 4 of the main menu gives access to a number of application programs which will be increased as the system grows. Figure 18 illustrates this menu.

LOGAN / C		Time: 10:21:15
EXTERNAL ANALYSIS		Date: 06/20/86
1-4		User: BRUNO
6) GRAPHICS	A) Others	
1) Nodes	1) Capacity analysis	
2) Streets	2) Traffic light coordination	
3) Intersections	3) Printed list of traffic signs	
4) Traffic signs	4) Printed list of sign posts	
5) Sign posts		
5) Pavement markings		
6) Accidents		
	D) Return to main menu	
	F) Exit this menu	
	H) Help	
	P) Printer (setting)	
	X) Return to DOS	

Figure 18. Menu to give access to the application programs.

There are several graphical programs to display the information contained in the base. The first gives a map of the geo-coded network. (figure 19)

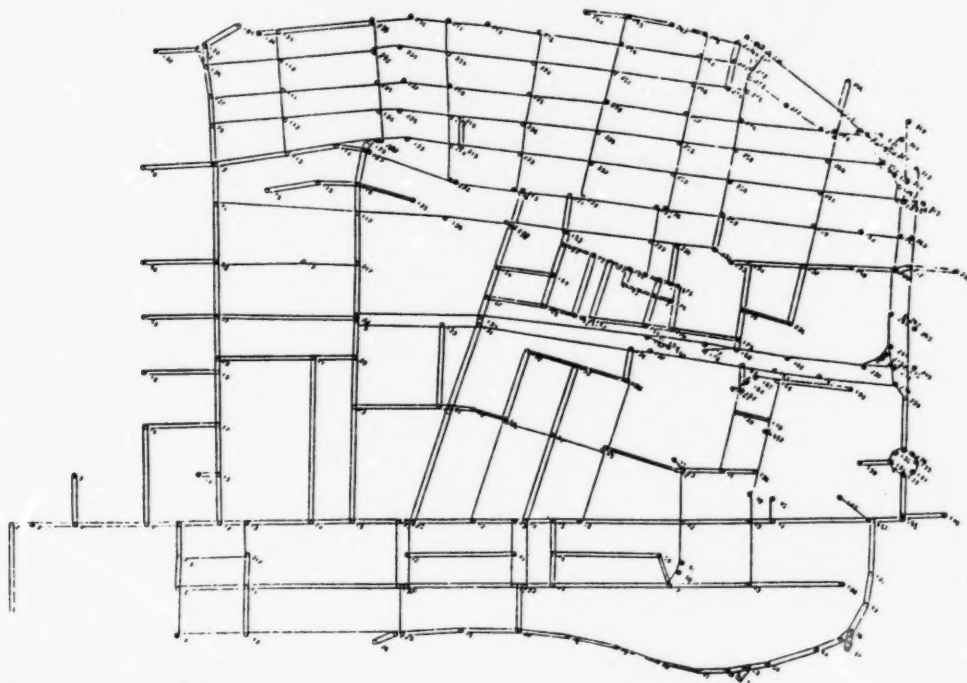


Figure 19. Drawing of the network used in the pilot study.

The second draws the intersections in two ways, one with traffic markings and dimensions and the other with the existing traffic control signs. These two options are illustrated in figures 20a and 20b.



Figure 20a Intersection with
pavement markings



Figure 20b. Intersection with
traffic signs

Option A3 permits use of a program which illustrates the coded traffic sign information in a stylized way on a line printer. Signs are not drawn but are represented by their code; their positions, nevertheless, are to scale. Figure 21 shows an example.

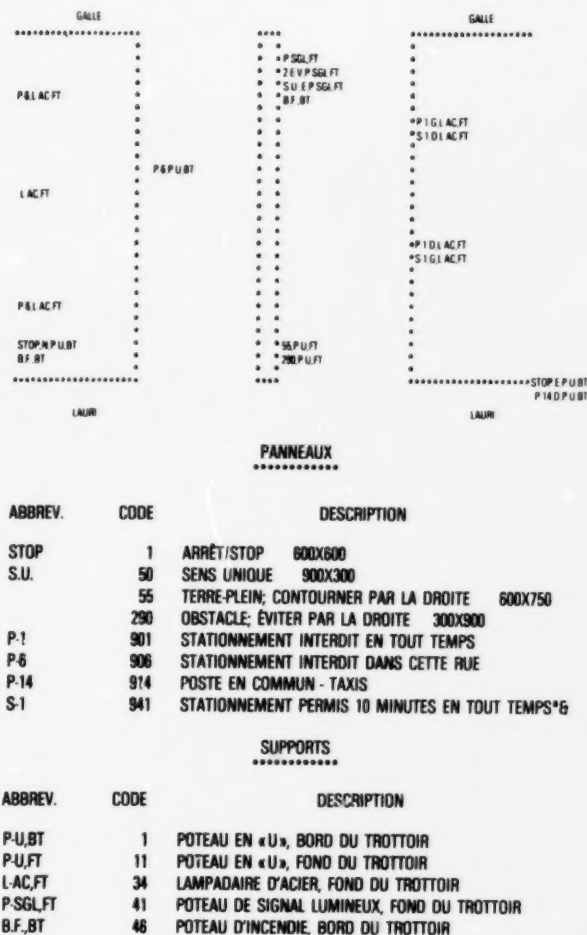


Figure 21. Representation of the position of traffic signs on a line printer.

The explanations of the sign codes are printed beneath the drawing. The program works in an interactive mode and can easily and rapidly access the data. For further details see Gourvil (1982).

Many programs exist, in traffic engineering, for different tasks. For example; for traffic light coordination (TRANSYT, PASSER) or volume data treatment (COUNTS). These programs are generally prepared by companies outside the

traffic engineering department and data entry is extremely rigid and time consuming which diminishes their usefulness. The integrated data base contains, however, all the needed information for these programs (except certain parameters which have to be entered interactively). There is a special programmed interface program which automatically extracts the necessary data and asks the user to add other needed parameters. This makes the data independent of the special application programs. The methodology of the data extraction is very similar for different programs. Work is underway to design an efficient program which prepares data for application programs. Presently there are two interfaces, one for coordination of traffic lights on an artery (algorithm of Little, 1965) and one for the treatment of traffic volume data. The principle of use of a program interface is briefly described by an example of the traffic light coordination. Necessary data are parameters like progression speeds, cycle lengths, volumes, distances between intersections, time splits at traffic lights. All data (except the speed and cycle length, if the existing values are not used) are contained in the data base. The user has to specify the name of the artery to be synchronized (5 letter code) and the beginning and ending intersection of the coordination. The interface program asks for cycle lengths and for speeds. Outputs can be directed to screen or to the printer.

These menus and underlying programs contribute to an easy and pleasant use of the information system, even if the present system is in the developmental phase. The following objectives are attained:

- Better use of the collected data (analysis and extraction)
- Reduction of the traffic data collection work.
- Standardization of present working procedures.
- More frequent use of the application programs and easier program development.
- In the future: use of the information system for planning purposes and for decision making.

The successful implementation of such a computer based information system depends very much on the participation and continuous consultation of the potential users during its development. The system has to adapt to the demands of the user and not the opposite and has to grow with the needs. One should not

believe that a complete system could be developed in a single step. Given the modularity of the chosen DBMS which allows easy adding and changing of the data and data storage structure, the information system can, in a first step, be conceived globally and limit data introduction to the presently available data and allowing a progressive enlargement of the base with future integration into other urban data bases.

Stepwise introduction of such a system also alleviates certain psychological difficulties to the user created by the introduction of a global system which needs a very big amount of data without producing an immediate beneficial and practical result.

THE APPLICATION

The system was initially designed for small or medium sized cities. It was applied to a sector of the City of Quebec with a network of 322 nodes and 290 geo-coded links. The area of the sector was approximately 1.2 km² and there were 2040 traffic signs.

Another application intends to prove the feasibility of the system in a larger city and data were collected from a traffic sector in Montréal. This work is under way.

The information system resides on an IBM AT computer with color graphics and a 20 MB hard disk. Response time, even for the longest search through the file of traffic signs, is very good.

CONCLUSION

The DBMS programs are in rapid and constant evolution and provide more and more useful commands and user friendly information treatment. As micro-computers become more powerful and storage capacities increase constantly, the proposed approach becomes feasible also for medium and larger sized municipalities. The advantages of the proposed information system based on the well known and widely distributed DBMS are numerous.

Data are not redundant, are easily kept up to date and the access is controlled by password security. Data or combination of data can be treated either directly by means of available commands or can be used for application programs. Due to a common link, the information is accessible to all city departments,

which improves planning, operation and decision making.

A global centralized urban information system would be theoretically perfect. In practice, however, it is difficult, time consuming and costly to develop from scratch. A stepwise development is preferable with the objective of integration in mind.

It is recommended that each municipal department develop a data base at its rhythm, corresponding to its needs and this following a development plan which assures a perfect compatibility of data coming from different departments. This would allow common use of the data. The common use is possible by recent development of the local area networks (LAN).

The pilot project has demonstrated the feasibility of the approach. Supplementary development in the field of interfaces between application programs and the information system will be carried out, in order to improve the usefulness of the system and make it an efficient tool for economic decision making and providing aid for planning, development and day to day operation of the traffic engineering system.

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